SHAFT-SINKING METHODS AND COSTS AT THE T. L. SHAFT, EUREKA CORP., LTD ., EUREKA, NEV.

BY A. C. JOHNSON

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by

A. C. Johnson[2/]

SUMMARY

The T. L. shaft of the Eureka Corp., Ltd., near Adams Hill, Eureka, Nev., was sunk in 1954 and 1955 to permit exploration and development of the lead-zinc-silver ore that had been indicated by drilling.

This paper describes the sinking of the 4-compartment, vertical shaft to a depth of 1,127 feet and includes pertinent details of equipment, methods, and costs. A shaft crew of 10 men, supplemented by 13 hoistmen, topmen, carpenter, and shop crewmen, sank and timbered the 1,127 feet of shaft in 630 workdays. Total labor per foot of shaft was 107.95 man-hours. Supplies per foot of shaft included 20 pounds of explosives, 1.61 pounds of drill steel, and 200 board-feet of timber. Power consumption, including that required for pumping, averaged 3,726 kw.-hr. per foot.

INTRODUCTION

This information circular describes shaft-sinking methods and costs at the T. L. shaft of the Eureka Corp., Ltd., Eureka County, Nev. It is one of a series being prepared by the Bureau of Mines on mining methods, practices, and costs in various mining districts of the United States.

The Eureka mining district is on the northern side of the Prospect Mountain Range in eastern Nevada. Eureka, county seat of Eureka County, is about 90 miles south of Palisade, a station on the Southern Pacific Railroad. Ruby Hill is about 2 miles west of Eureka and has been the center of mining activity in the district (fig. 1).

ACKNOWLEDGMENTS

The author thanks Thayer Lindsley, president of the Eureka Corp., Ltd., for whom the shaft was named, for permission to use data presented in this report. Special acknowledgment is made to George W. Mitchell, vice president and general manager, for information on sinking procedures and operation of the shaft. The author also thanks Robert Breckenridge, general superintendent, and Vernon Manz, superintendent, for information on general operations. Acknowledgment is due to Tom Kelley, master mechanic, for information on mechanical operations involved, and to Walter Paroni, senior engineer, for maps furnished and general information on the shaft.

1/ Work on manuscript completed August 1956.

2/ Supervising mining engineer, Bureau of Mines, Region II, Reno, Nev.

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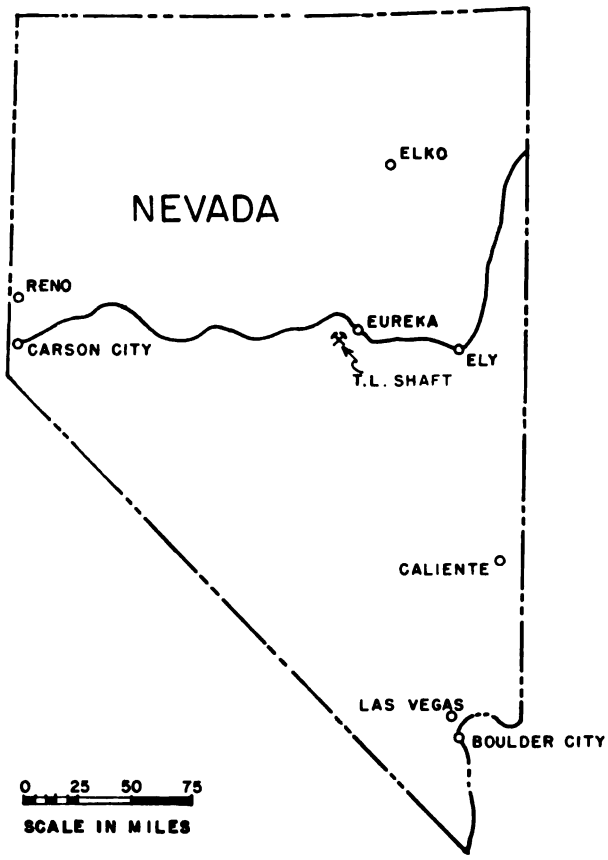

Figure 1. - Location map.

PURPOSE OF SHAFT

During 1953 the Eureka Corp., Ltd., began a drilling program to explore an area near Adams Hill, 1 mile northwest of the Fad shaft (fig. 2). Drilling was begun to prospect the Hamburg dolomite to its base, about 1,100 feet below the surface.

The program consisted of drilling a series of widely spaced rotary drill holes starting near the Cyanide shaft and moving toward the Holly and Bullwhacker mines 2,500 feet north (fig. 2). The resulting proof of strong mineralization lead to a shaft sinking and underground exploration campaign.

PHYSIOGRAPHY AND GEOLOGY

The summit of Adams Hill is about 3,400 feet almost due north from the top of Ruby Hill. The hill rises to a height of 6,940 feet above sea level and slopes with gradual descent toward the valleys on the west and north. It is divided from Ruby Hill by a moderately deep ravine, which enters Spring Valley.

A large part of the hill is composed of Hamburg limestone, the Secret Canyon shale runs east and west along its southern flank, and the Dunderberg shale appears in a like manner on the northern slope. North of the Dunderberg shale and east of the Hamburg dolomite the Pogonip limestone is exposed. North of the Dunderberg shale in the Pogonip limestone is a large outcrop of quartz-porphyry; and still farther north in the same rock, a smaller exposure of quartz-porphyry is visible underground in the workings of the Bullwhacker mine. The dip of all the formations of Adams Hill, including the Secret Canyon shale, is to the north and east.

PREPARATION OF SURFACE

An area having sound rock formations was selected for the site for the T. L. shaft. Figure 3 is a plan of surface layout at the T. L. shaft.

Necessary blasting and bulldozing prepared the surface for the hoist house and headframe. Building the access road and clearing the site cost $12,500. Early in the sinking program a well-designed concrete collar was poured, and concrete piers for the front legs of the headframe were set. Excavation for the concrete collar was carried into bedrock to insure solid footing and seal off surface water. A 10- by 10-foot crib was built on the backside of the concrete collar and carried above the ground to give dump room and provide surface drainage away from the collar of the shaft. Bearing sets of steel were placed in concrete.

Materials and plant equipment were hauled to Eureka by truck. The timber for the shaft was hauled from northern California. Diesel oil was transported by trailer trucks from Salt Lake City, Utah.

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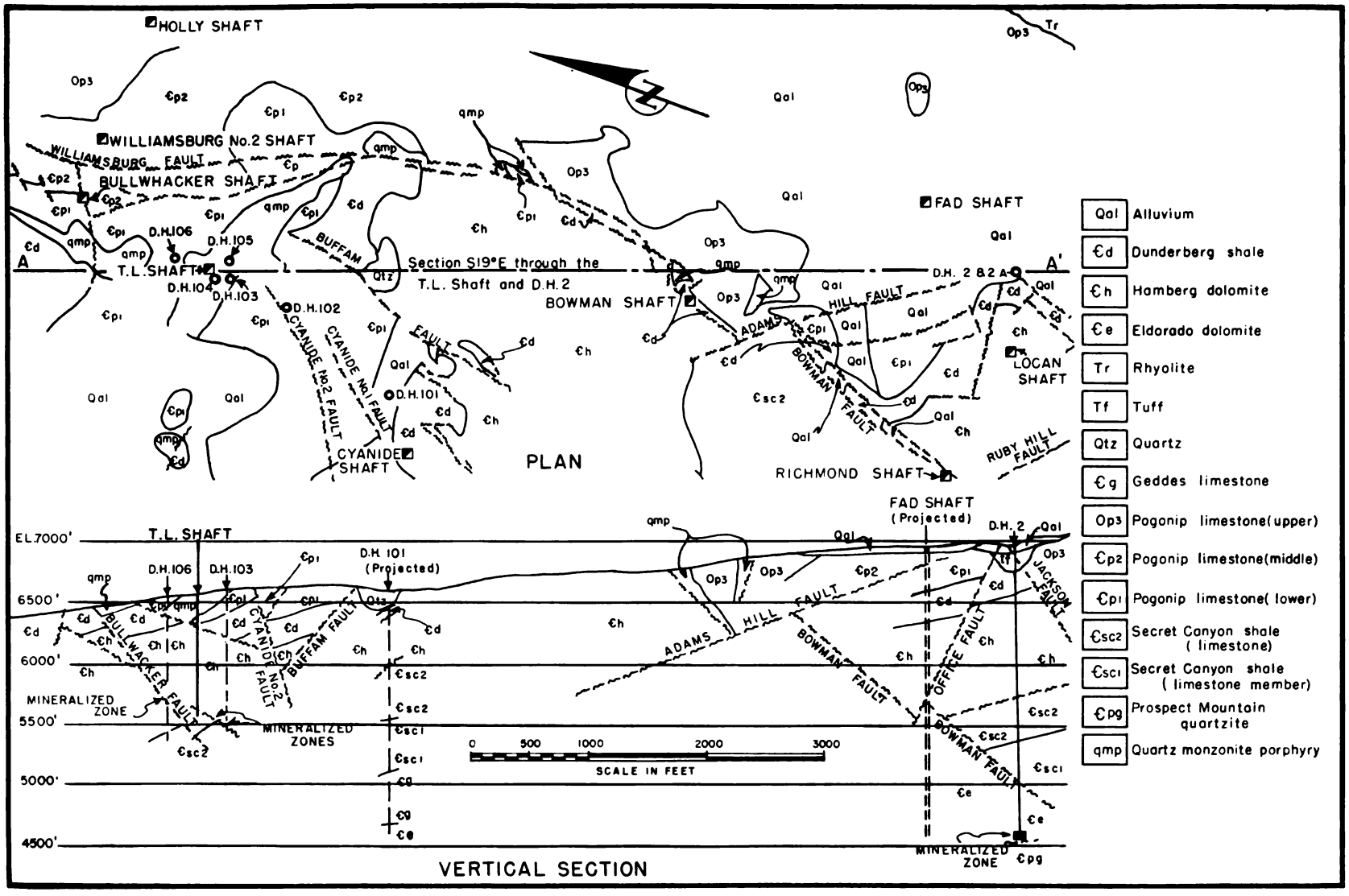

Figure 2. - Plan and vertical section, T. L.-shaft area.

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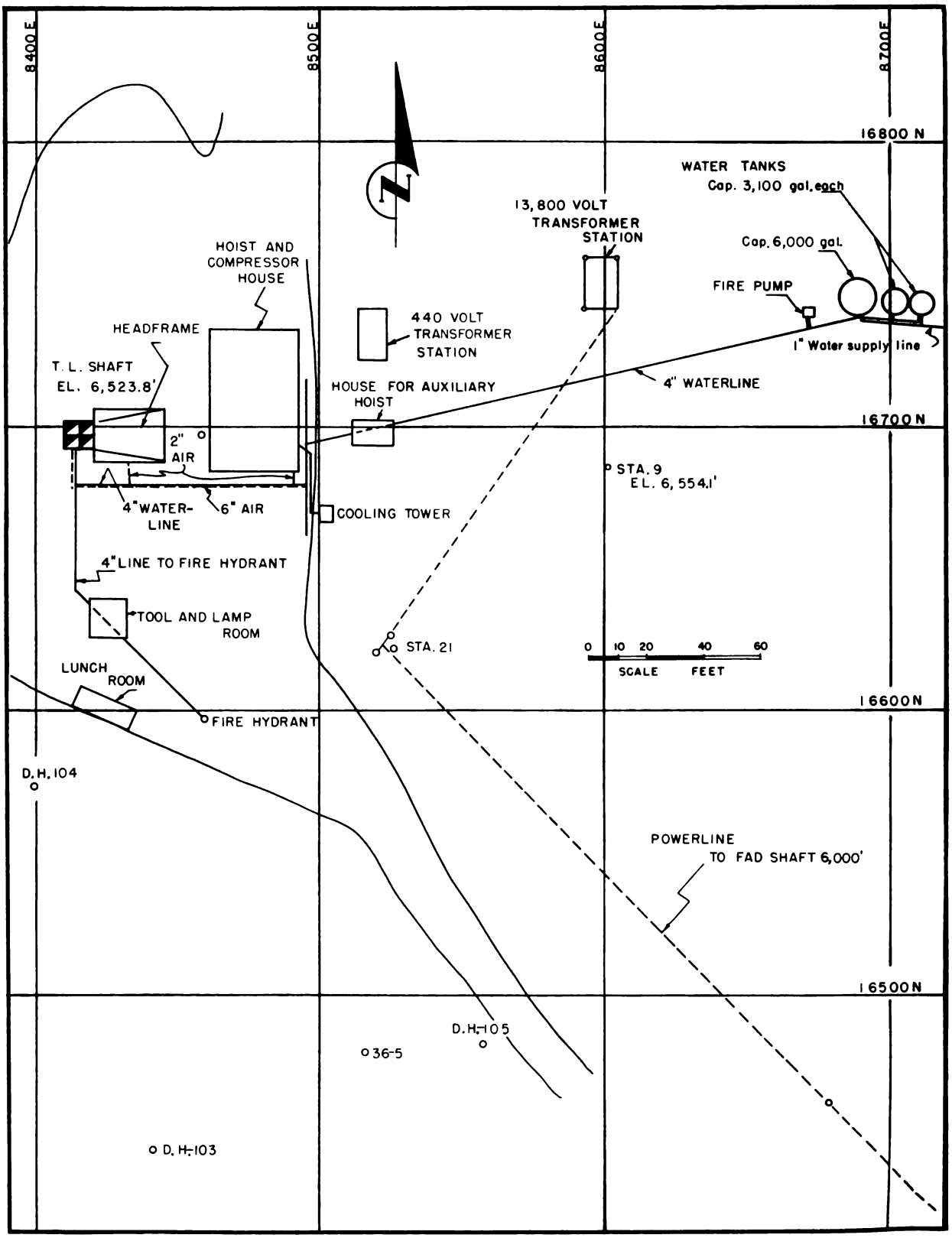

Figure 3. - Plan of T. L.-shaft surface layout.

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SHAFT PLANT AND EQUIPMENT

Principal plant units included a 46-foot wood headframe, electrically driven hoists and compressors, surface pipelines, pumps, powerplant, 6,000-foot powerline, and a substation containing 2 banks of 1,500-kv.-a., 13,800- to 2,400-volt transformers.

The following permanent buildings were constructed:

Building	Size, feet	Type of construction
Hoist and compressor house	30 x 40	Wood framing covered with aluminum.
Topman's house	10 x 15	Wood framing covered with galvanized iron.

Two temporary explosives magazines were also erected.

The total cost of the structures was not strictly chargeable to shaft sinking, because they were designed to also serve during later underground exploration and development. The same was true for the larger items of equipment.

Surface installations

	Cost
Hoist and compressor house	$ 4,000
Topman's house	1,000
Substation	20,000
Powerline	12,000
Explosives magazine	800
Detonator magazine	200
Total	$38,000

The main hoist is a 3- by 4-foot, double-drum, Joshua Hendy electric hoist having a rope-pull capacity of 7,500 pounds on a single line at a speed of 550 feet per minute, powered by a 150-hp., 440-volt, 3-phase, 60-cycle, slipring motor, and equipped with 2 air-operated clutches.

The auxiliary or chippy hoist (J. George Layner) is single-drum, 42- by 24-inch, equipped with a double reduction gear and driven by a 50-hp., 440-volt, 3-phase, 60-cycle, squirrel-cage motor with a rope speed of 250 feet per minute. The cable on the main hoist is 1 inch in diameter, 18- by 7-strand, preformed, regular-lay, nonspin, improved plow steel. The cable used on the auxiliary hoist is 5/8 inch in diameter, 6- by 19-strand, preformed, lang-lay, improved plow steel.

The compressor plant consists of a Chicago-Pneumatic and a Sullivan unit, each delivering 350 cubic feet of free air per minute at 100 pounds pressure per square inch. Each compressor is powered with a 75-hp. electric motor.

A 46-foot timber headframe equipped with two 5-foot head sheaves was erected over the 4-compartment shaft. These compartments were equipped with the necessary safety doors and chutes for dumping the sinking buckets (fig. 4).

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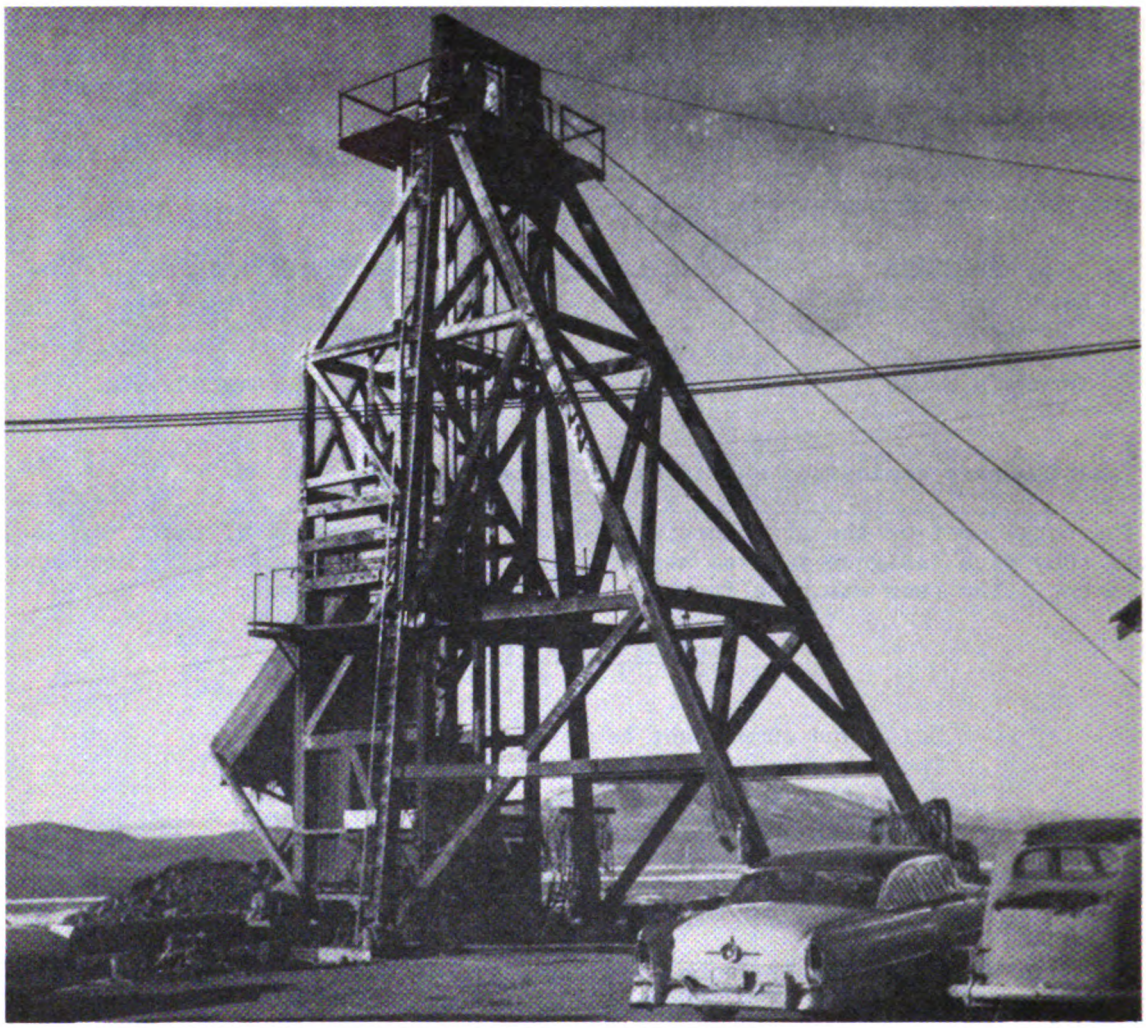

Figure 4. - T. L.-shaft headframe.

Surface plant equipment

	Cost
Joshua Hendy hoist, installation, and foundation	$15,000
Auxiliary hoist (installation and foundation only)	1,000
Headframe	8,500
Compressors (installation and foundation only)	1,500
Total	$26,000

The auxiliary hoist and the compressors were used in sinking the Fad shaft and were not charged as a capital cost to the T. L. shaft.

The 45- by 135-foot building housing the powerplant is framed of 8-by 8-inch timber and has two 5-ton traveling cranes to facilitate maintenance. The siding is of 1-inch shiplap, building paper, and galvanized corrugated iron. Two-inch T & G diagonal sheathing, roofing paper, and galvanized corrugated iron cover the roof. Metal sashes are used on all the buildings; and the windows are of extra-heavy, wire-reinforced glass.

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The full basement keeps the main floor free of piping, auxiliary units, and electrical equipment and is used for storing spare parts. The concrete floor is designed to withstand the pressures of the heavy generating units.

All paint used on woodwork is fire retarding, and safety considerations dictated the color schemes.

The powerplant consists of 3 identical Worthington SEH-8, 4-cycle, 360-r.p.m., turbo-charged diesel engines, each directly connected to a 1,000-kw., 2,400-volt, 300-a. General Electric generator. Excitation for the generator is supplied by a belt-driven, 15-kv.-a., 125-volt generator. Each diesel has the foregoing rating at 7,000 feet elevation. One generator was used for sinking operations, and 2 other generators were on standby.

Diesel oil was hauled from Salt Lake City by tanks and trailers. The power consumption for the operations involved in sinking the T. L. shaft was 200,000 kw.-hr. per month.

SHAFT SINKING

Preparatory work was begun late in December 1953, and the shaft was completed at a depth of 1,127 feet in August 1955. At approximately 840 feet the shaft penetrated a brecciated fault zone, from which a large quantity of unconsolidated material caved into the shaft. Sinking was temporarily stopped at the 850-foot level to timber and dry-pack the fault zone. A series of holes was also diamond-drilled to determine and outline the extent of the unconsolidated material. Figure 5 shows the position of the fault zone and the method of timbering and dry-packing used to prevent further caving.

The shaft is 11 by 11 feet, rock dimensions, and is timbered with 8- by 8-inch, treated-wood sets. Two of the four 4- by 4-foot compartments (dimensions clear of timber) are equipped for hoisting. The remaining compartments are for manway, air, water, and power lines (see fig. 6). The manway compartment is equipped with wooden ladders and has landings spaced 15 feet apart.

The pipelines are a 4-inch airline, one 10-inch pump discharge column, a 1-inch waterline to supply the rock drills, and an 18-inch, spiral-welded, hot-tar-dipped, 12-gage steel ventilating pipe with slip joints. Tees have been inserted in all pipelines opposite the stations to provide connections for later cross-cutting and drifting.

Stations for exploration and development were cut on the 850-, 950-, and 1050-foot levels. Figures 7 and 8 show the general plan of the 850- and 950-foot-level stations. Figure 9 shows details of the 950-foot loading pocket.

A No. 9 vent air fan, made by Coppus Engineering Co. and driven by a 25-hp., 440-volt, a. c. motor, is used for ventilation. It is installed at the collar of the shaft and used to exhaust through the 18-inch ventilating column. Booster fans of the same size are installed on the 850- and 950-foot levels. This equipment removed all fumes and dust from blasting in 15 to 20 minutes.

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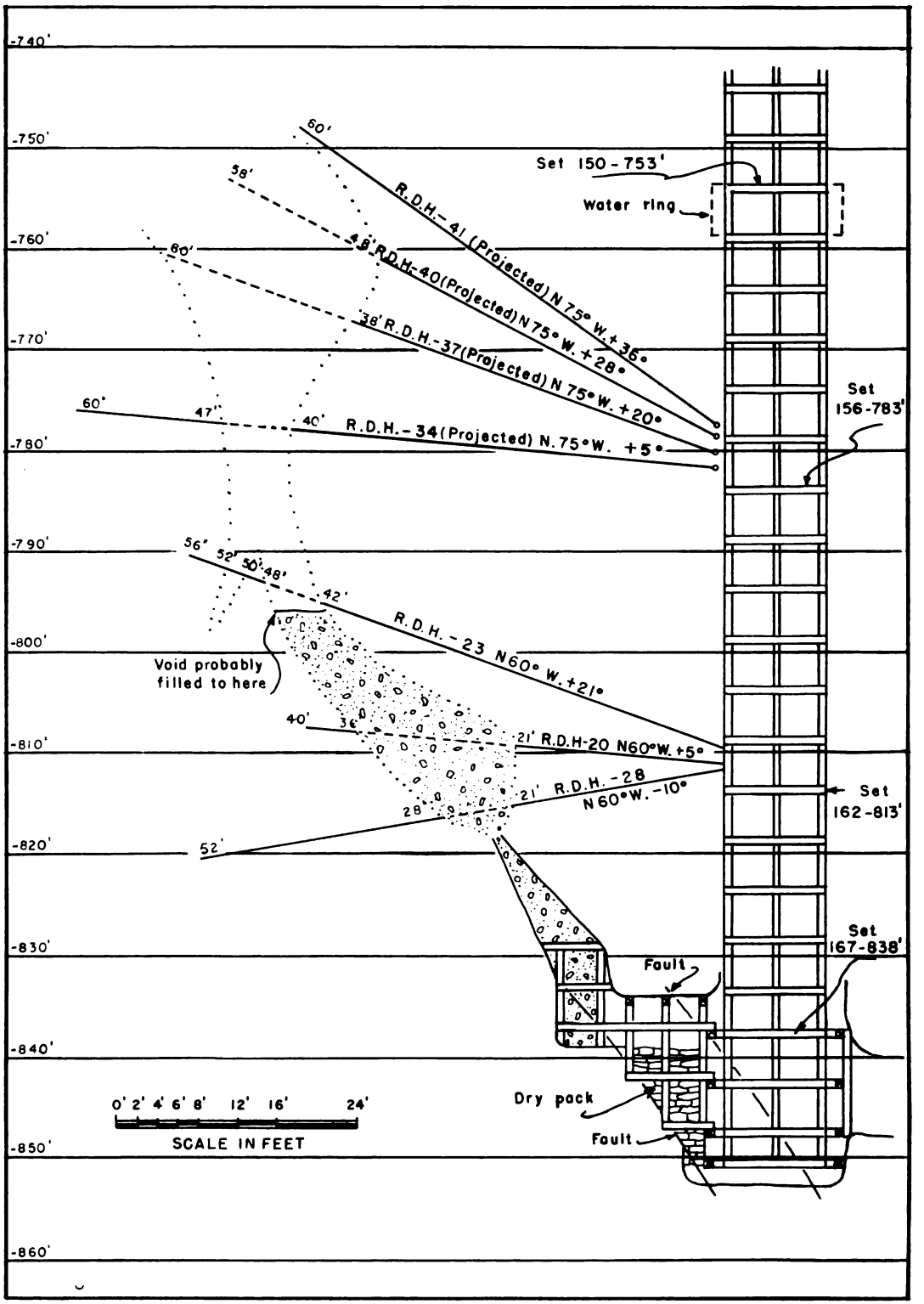

Figure 5. - Section through northwest corner of T. L. shaft, showing method of timbering and dry packing to prevent further caving.

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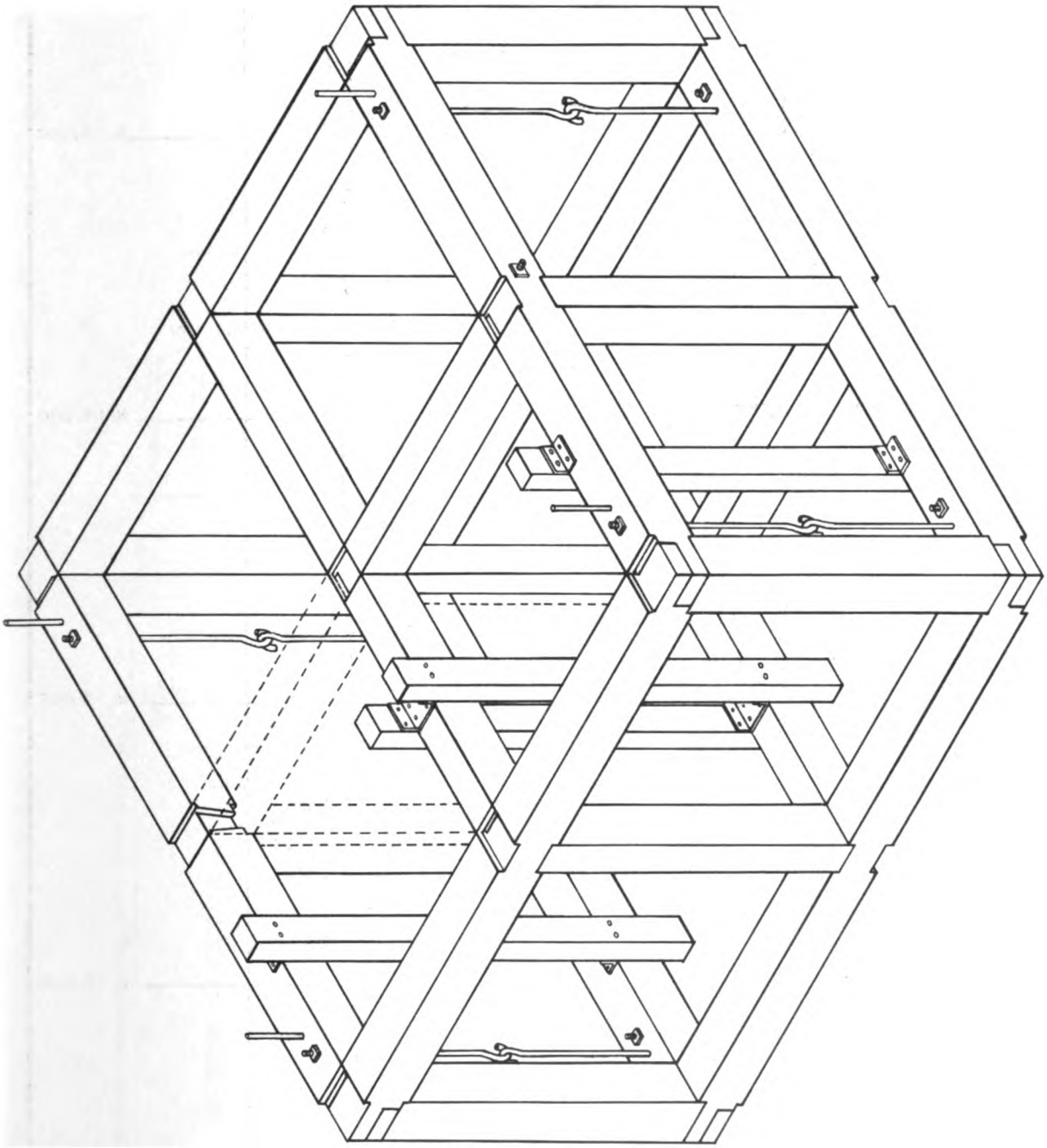

Figure 6. - Isometric view of T. L.-shaft timber.

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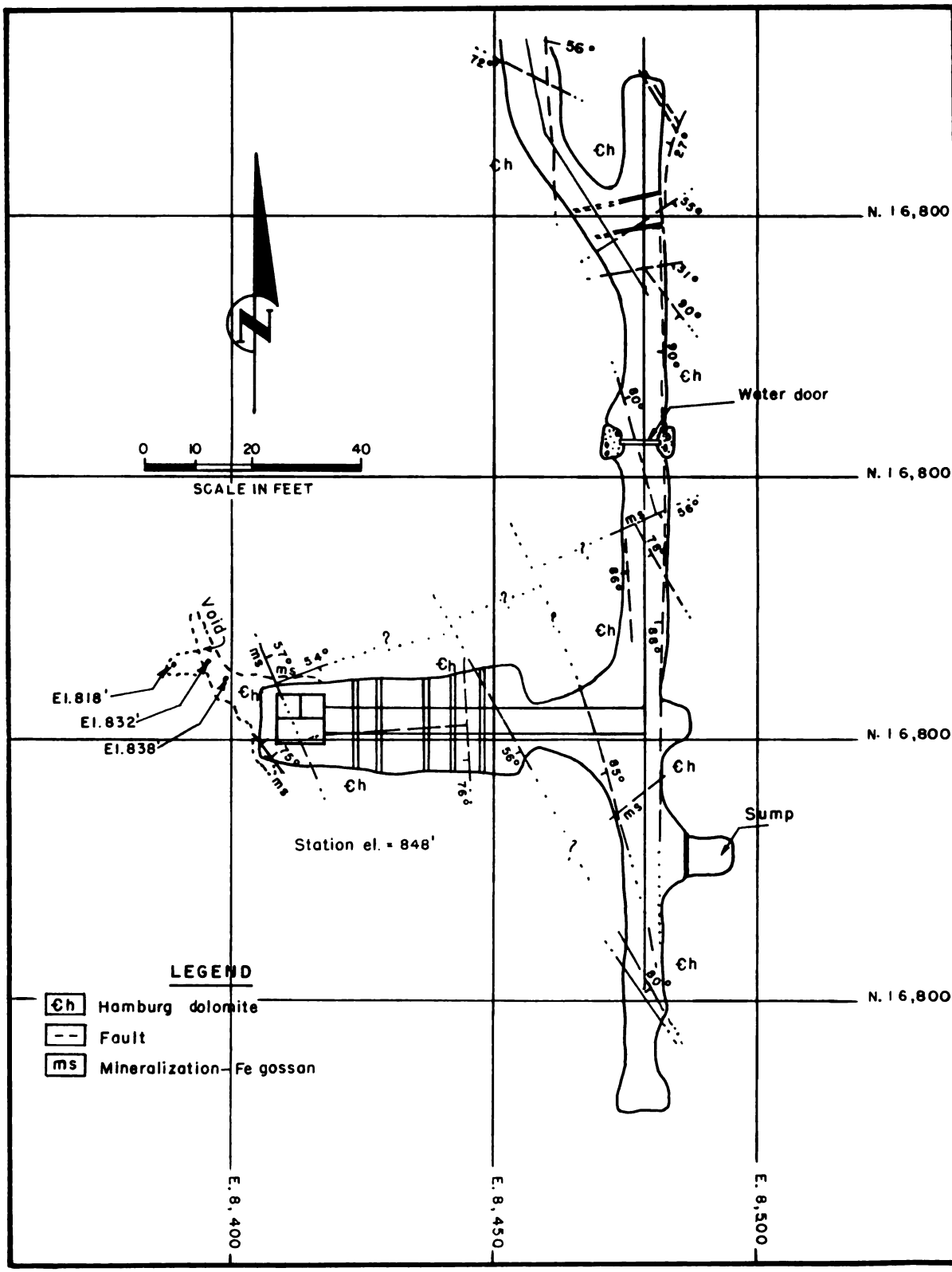

Figure 7. - General plan, T. L.-shaft 850-foot level station.

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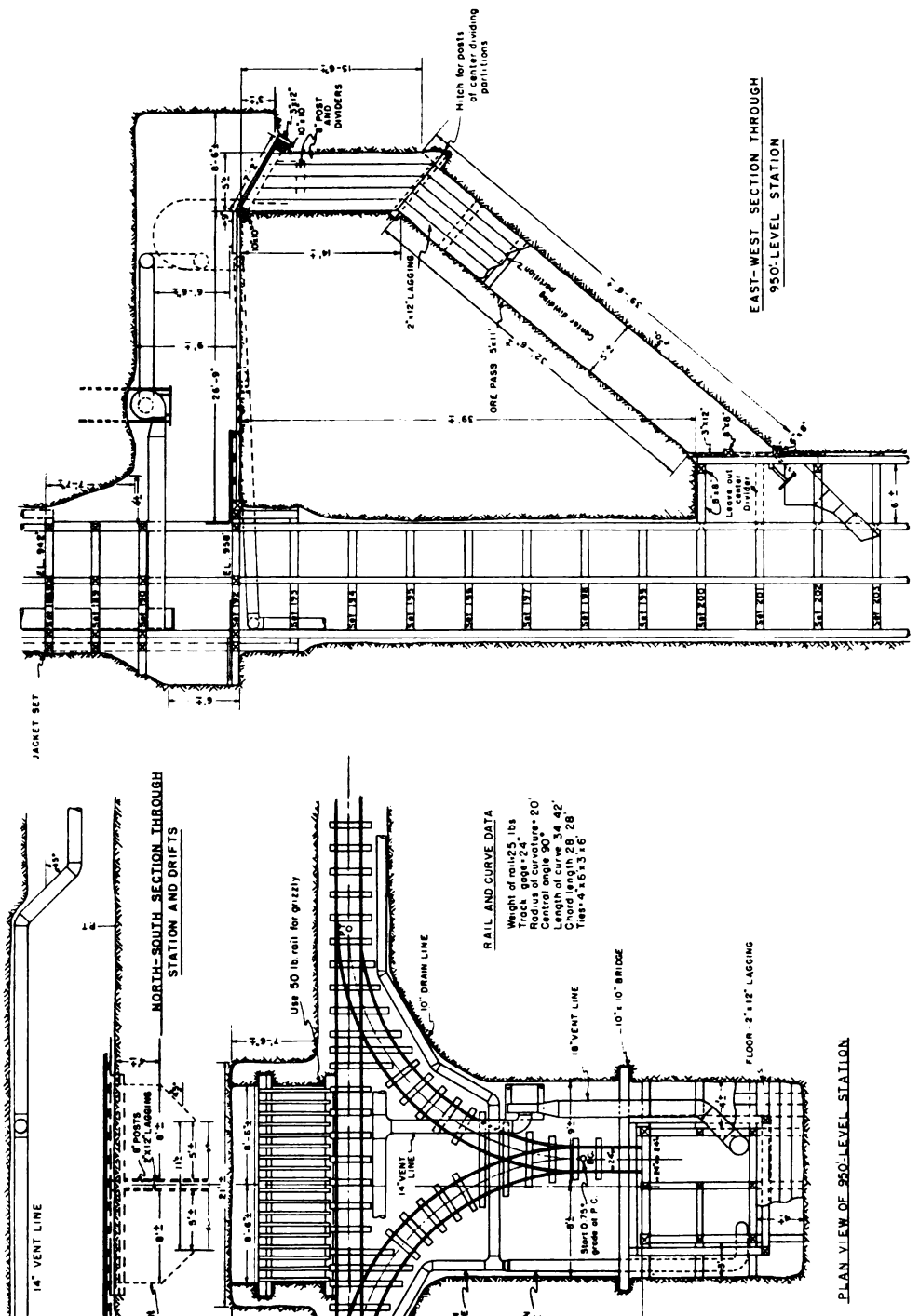

Figure 8. - General plan, T. L.-shaft east-west section through 950-foot level station.

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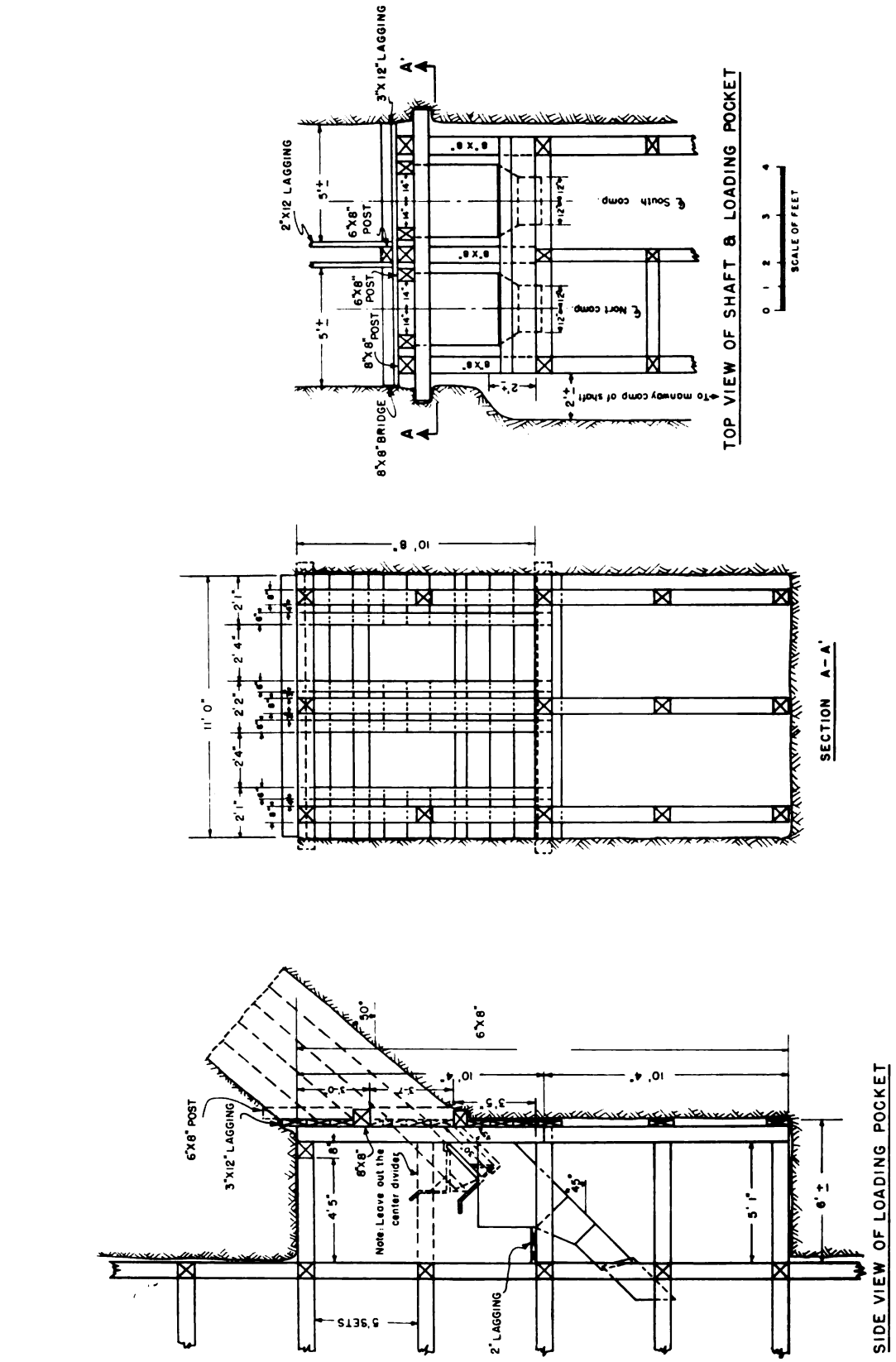

Figure 9. - Detail of 950-foot-level loading pocket.

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Sinking equipment consisted of the usual rock drills, hose and accessories, sinking buckets, crosshead, pumps, signaling system, and small tools. The crosshead is shown in figure 10. The cost of underground equipment is itemized as follows:

Rock drills:	
5 jackhammers	$ 3,000
Underground pumps and motors:	
3 100-hp. sinking pumps	18,000
2 50-hp. station pumps and 5 40-hp. station pumps	19,500
3 2-drum slusher hoists	5,000
2 safety crossheads	1,000
1 scraper	1,000
3 27 cu. ft. sinking buckets	3,000
4,500 feet of rubber-covered power cable	13,500
Total	$64,000

The sinking equipment is written into the operating costs and is included in the sinking costs. The design of the sinking bucket is shown in figure 11.

The crew worked three 8-hour shifts, 7 days a week, in a continuous cycle of drilling, mucking, and timbering. It consisted of 3 miners in the shaft; 1 miner acted as a shift leader. All shifts worked under the direction of the superintendent and the general foreman. A topman worked at the shaft collar on each shift. After water was encountered, one extra shaftman was added to each shift. A hoistman on each shift operated the hoists and serviced the air compressors.

Three mechanics, a master mechanic, an electrician, and his helper formed the shop crew. The bull gang, carpenter crews, and diesel operators totaled 14 men. An accountant, a part-time clerk, and a purchasing agent were in charge of the stores and office work.

Cycle of Operation

The shaft crew was made up of miners and a working-shift leader. These men were competent and capable of performing any part of the work cycle. The shaft sets were placed as often as required; however, a 20- to 25-foot section was necessarily left untimbered at the bottom of the shaft to allow working room for the clamshell mucker.

Drilling

A V-type round was most efficient in breaking the ground. An average of 30 to 35 holes was drilled per round, of which 6 were cut holes. Three men in the shaft, using 2 drills, required 3 to 5 hours to set up equipment, drill the round and remove gear preparatory to blasting. The machines were 2 3/4-inch sinkers. After each drillround the machines were inspected and serviced in preparation for the next round. Drill steel used was 1-inch quarter octagon, and 1,812 pounds was consumed in sinking - a destruction of 1.61 pounds per foot of shaft.

A total of 364 Ingersoll type-I steel jackbits and 81 Timken carbide insert bits were used during the entire sinking operation. Four 2-foot changes per hole were made on the cut holes, and three 2-foot changes were made in the other holes. The changes and bit gages were:

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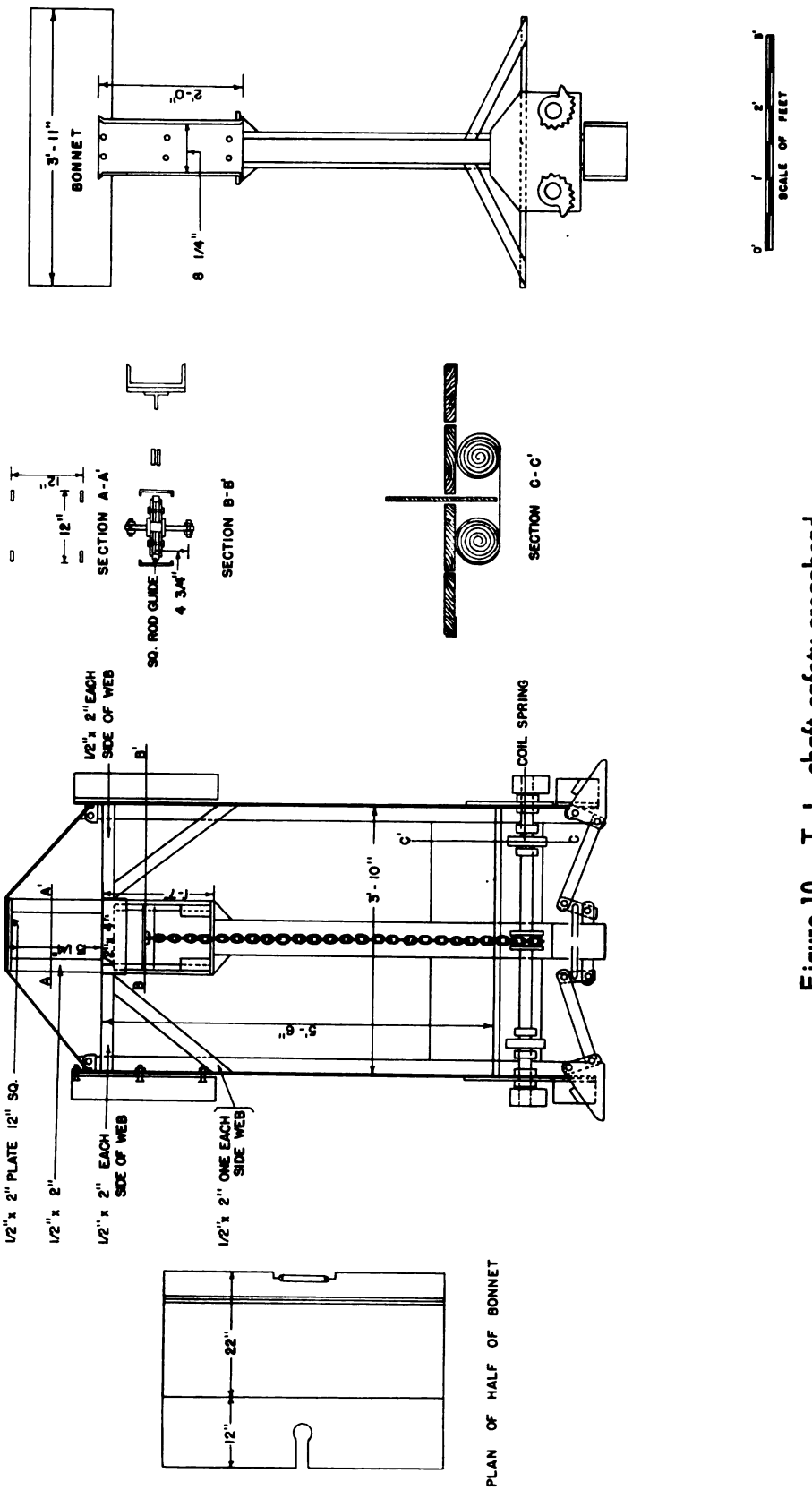

Figure 10. - T. L.-shaft safety crosshead.

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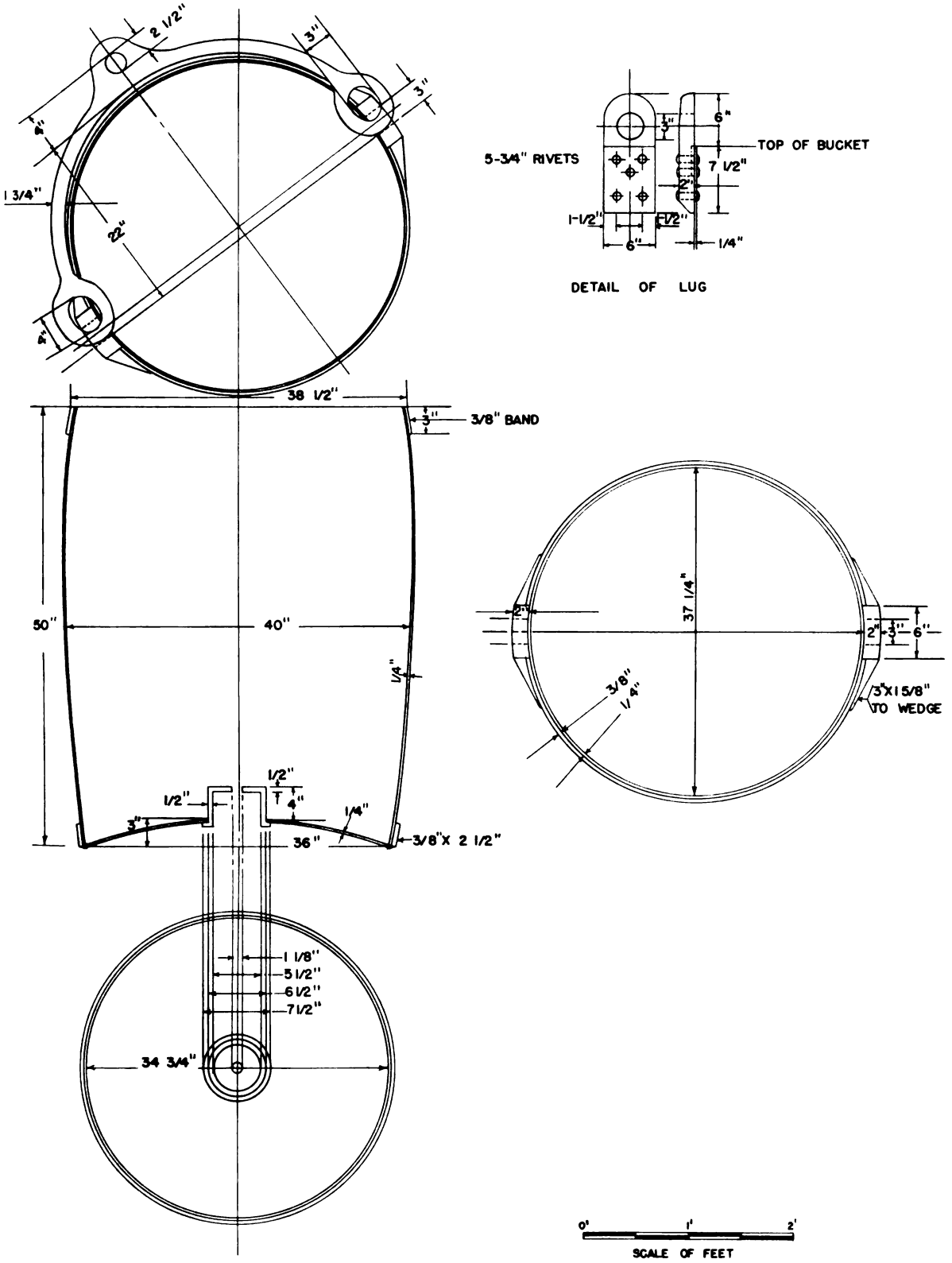

Figure 11. - Shaft bucket for T. L. shaft.

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Changes	Length, feet	Gage, inches
Starters	2	1 1/2
Seconds	4	1 7/16
Thirds	6	1 3/8
Fourths	8	1 5/16

Drills, steel, scaling bars, and tools were lowered and hoisted in one of the sinking buckets.

Wet drilling was practiced throughout the operation. Air at the machines was maintained as nearly as possible at 100 pounds.

Blasting

Forty-percent-gelatin dynamite was used for blasting. The cartridges were 1 1/8 by 8 inches. All blasting was done electrically from a 220-volt circuit.

Delay-action all-metal detonators (0 to 10 delay) were used and fired from an electric switch from the surface. A Tyrex two-conductor cable was run from the switch to the bottom of the shaft. The holes, with the priming cartridge about halfway down, were connected in series with No. 20 insulated connecting wire. The detonators were entirely waterproof, and only minor trouble was experienced from short circuits or misfires. The blasting circuit was closed by a switch having a special connector that could be inserted only after the switchbox was unlocked. Each shift leader carried a key and was responsible for the blasting.

Immediately before blasting, the pump was disconnected from the pump column and hoisted to the first set above the bottom of the shaft to protect it from the blast. After the round had been blasted, the pump was immediately lowered to the bottom of the shaft and re-attached to the water column.

Mucking

Mucking was done by a clamshell shaft mucker, mounted on a 4-wheel carriage that traveled across the shaft on 2 heavy steel rails, attached to the first shaft set above the bottom of the shaft. Two compressed-air motors were used to operate the clamshell bucket; one controlled the digging line, the other, the hoisting line.

The "hard-digging" clamshell bucket was equipped with front, side, and corner teeth and had a loading capacity of 3/8 cubic yards. It efficiently cleaned the bottom of the shaft, and only a small amount of hand mucking was necessary.

Timbering

The shaft was timbered with 8- by 8-inch Douglas fir. The timber, "Osmose," treated and framed at the California plant, was delivered to the property at a cost of $120 for a complete set. Figure 12 shows the shaft-set details.

The excavation for the concrete collar was carried into bedrock to insure a solid footing. The rock formation in the shaft was firm, which enabled the shaft crew to carry sinking operations 30 feet or more ahead of timber sets. The timber was lowered and hung in approximate position from the set above by means of hanging bolts. After assembly, the set was leveled, alined, and securely blocked in place. The average time to install a set of timbers was approximately 4 hours. At intervals of 150 feet, bearing sets, usually set in concrete, were installed.

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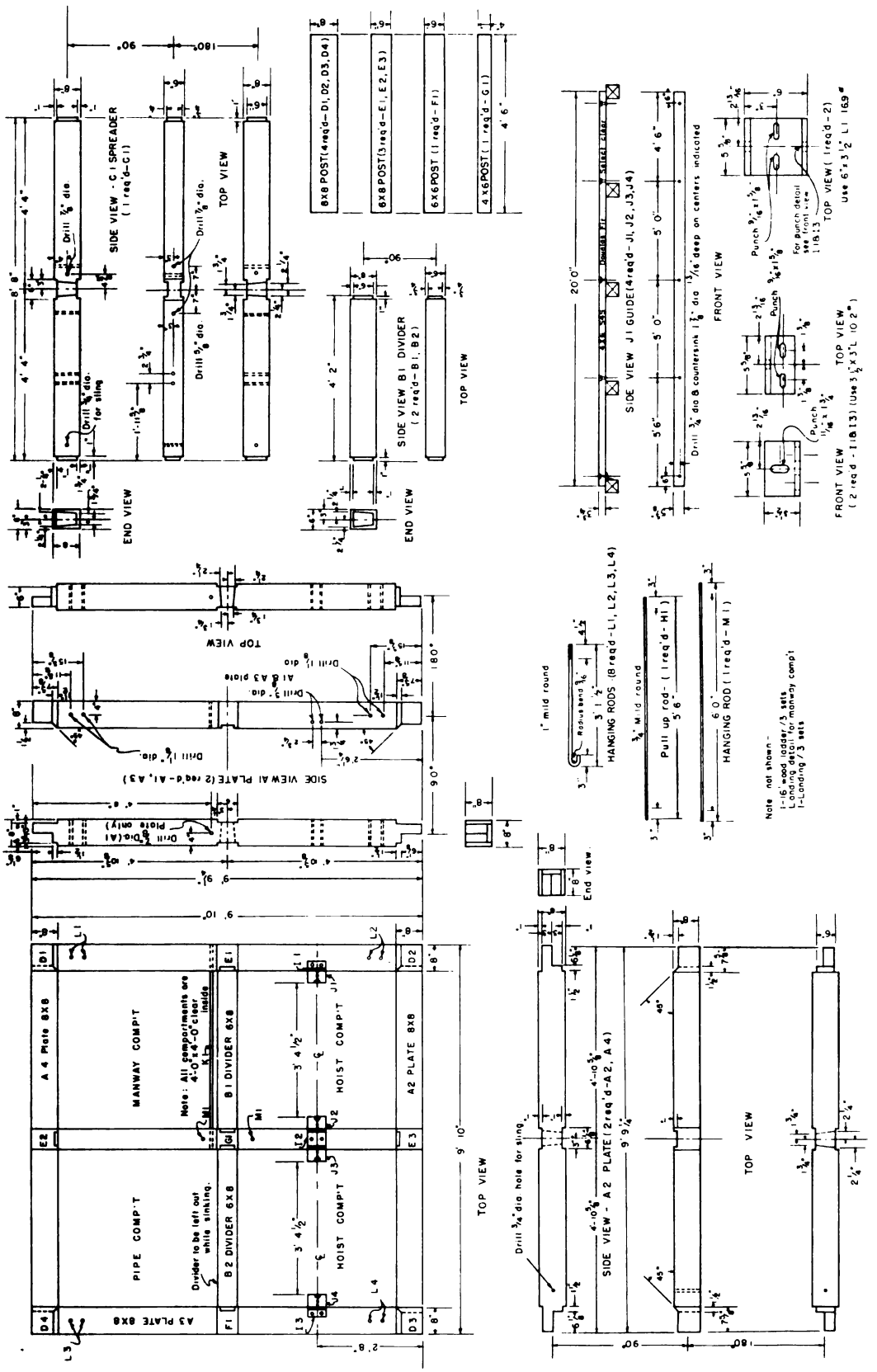
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TOP VIEW
END VIEW
SIDE VIEW B1 DIVIDER (2 req'd - B1, B2)
TOP VIEW
END VIEW
8X8 POST(4req'd-D1, D2, D3, D4)
6X8 POST(3req'd-E1, E2, E3)
6X6 POST (1 req'd - F1)
4 X 6 POST (1 req'd - G1)
SIDE VIEW J1 GUIDE(4req'd-J1, J2, J3, J4)
FRONT VIEW
TOP VIEW
SIDE VIEW A1 PLATE (2 req'd - A1, A3)
TOP VIEW
HANGING RODS (8 req'd - L1, L2, L3, L4)
Pull up rod - (1 req'd - M1)
HANGING ROD (1 req'd - M1)
Note : All compartments are 4'-0" x 4'-0" clear inside.
Divider to be left out while sinking.
A4 Plate 8X8
MANWAY COMP'T
B1 DIVIDER 8X8
A2 PLATE 8X8
PIPE COMP'T
B2 DIVIDER 8X8
HOIST COMP'T J1
HOIST COMP'T J2
HOIST COMP'T J3
A3 PLATE 8X8
SIDE VIEW - A2 PLATE (2 req'd - A2, A4)
TOP VIEW

Figure 12. - Shaft-set detail.

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PUMPING

Water was first encountered at a depth of 635 feet and increased progressively so that, at the 850-foot level, the flow amounted to 430 gallons per minute. At the bottom, or 1,127-foot level, the flow was 660 gallons per minute. Figure 13 shows the waterflow into the shaft from August 1954 to March 1956.

The main flow of water came from fractures in the dolomite. Concrete rings were placed at intervals in the shaft to catch water and act as bearing jacket sets.

A semipermanent pump station was cut on the 600-foot level, and two 250-hp. station pumps were installed (fig. 14). The sump on the 600-foot level has a live capacity of 7,000 gallons of water.

The station pumps are identical Ingersoll-Rand, 4 G. T., 2-stage, and have a rated capacity of 1,100 gallons of water per minute against a 600-foot head. They were driven by 250-hp., 3-phase, 60-cycle, 2,400-volt, 3,400-r.p.m. motors.

The sinking pump used was a Byron-Jackson, 12-stage, close-coupled, shaft-type, deep-well pump powered by a 100-hp., 3-phase, 60-cycle, 440-volt motor that was driven at 1,750 r.p.m. and was rated at 600 gallons of water per minute against a 600-foot head. The water was pumped from the bottom of the shaft to the 600-foot level sump. Two additional sinker pumps were retained as standbys (fig. 15).

The electric cables installed were 3/0, 3-conductor, 5,000-volt, rubber-covered, carrying 2,400 volts; the sinker-pump cable was smaller, rubber-covered, 600-volt, 3-conductor.

The station pumps were controlled automatically by electronic relays. Stainless steel probes, attached to the input circuit and inserted in the sump at the levels where the water was to be controlled, actuated the pumps through electronic relays. When the water in the sump made contact with the low-level probe, the first pump started and continued to run until the water was lowered and broke contact with the probe, which stopped the pump. If the first pump could not pump the water out as fast as it entered the sump, the rising water made contact with the probe, which automatically started pump 2. The second pump ran until the water was lowered enough to break contact with probe 2, which automatically stopped the pump.

A red light flashing on the starting panel in the hoist house warned the operator of high or low water in the sump.

The water pumped from the shaft was piped 3,000 feet from the shaft collar in a 24-inch steel pipe (fig. 16) and discharged through a measuring orifice into a ditch.

Installation on the surface of a Parshall flume equipped with a recording volume meter is planned. After being measured, the water will be discharged through the same line for 3,000 feet to an open ditch. Another Parshall flume will also be installed in the stream, 2 1/2 miles from the shaft to check the volume that may be recirculating to the shaft. The height of the water table is recorded daily by measuring the water level in 3 surface rotary drill holes, 2 of which are 250 feet north and south of the shaft; the third is 750 feet to the south.

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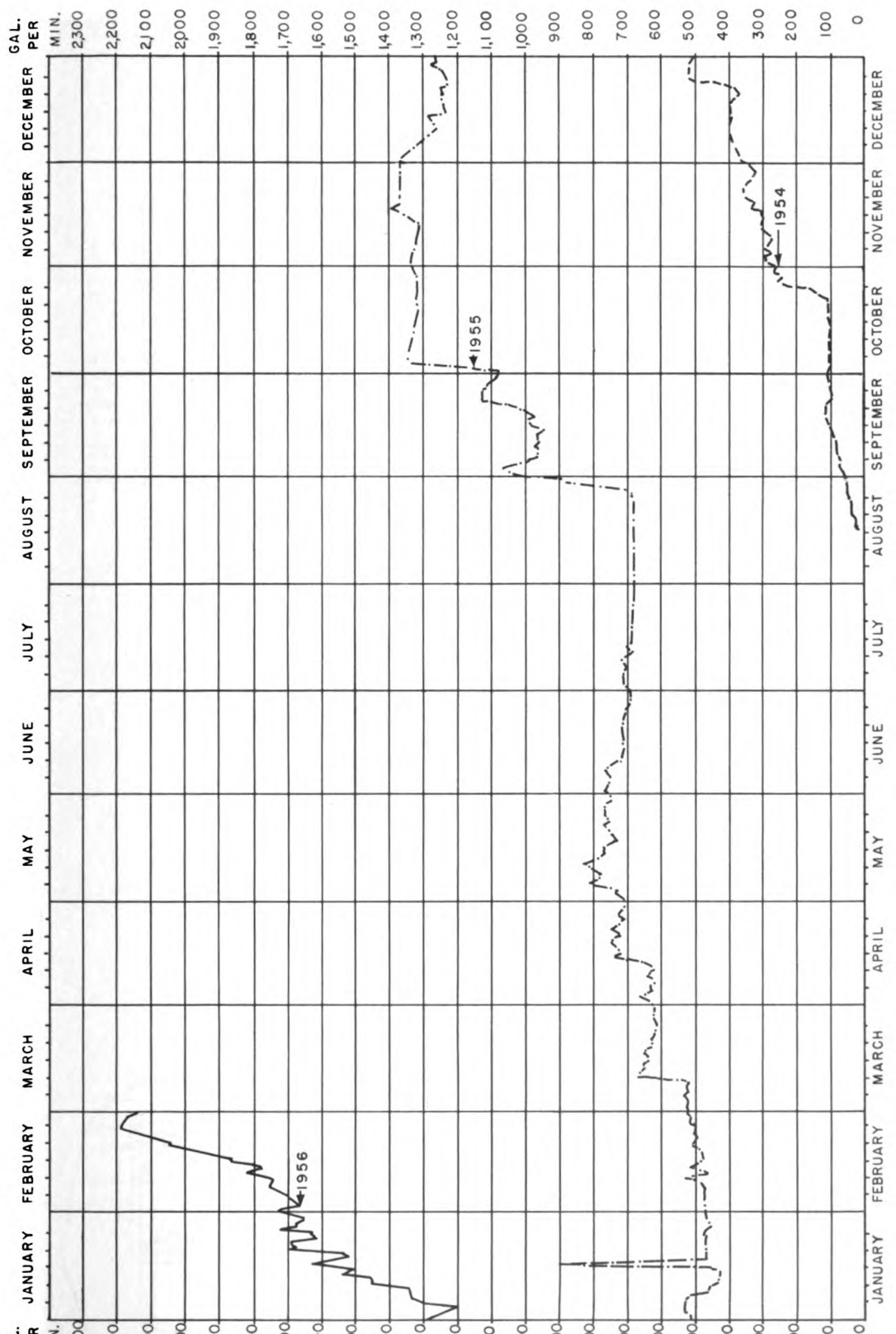

Figure 13. - T. L.-shaft water chart.

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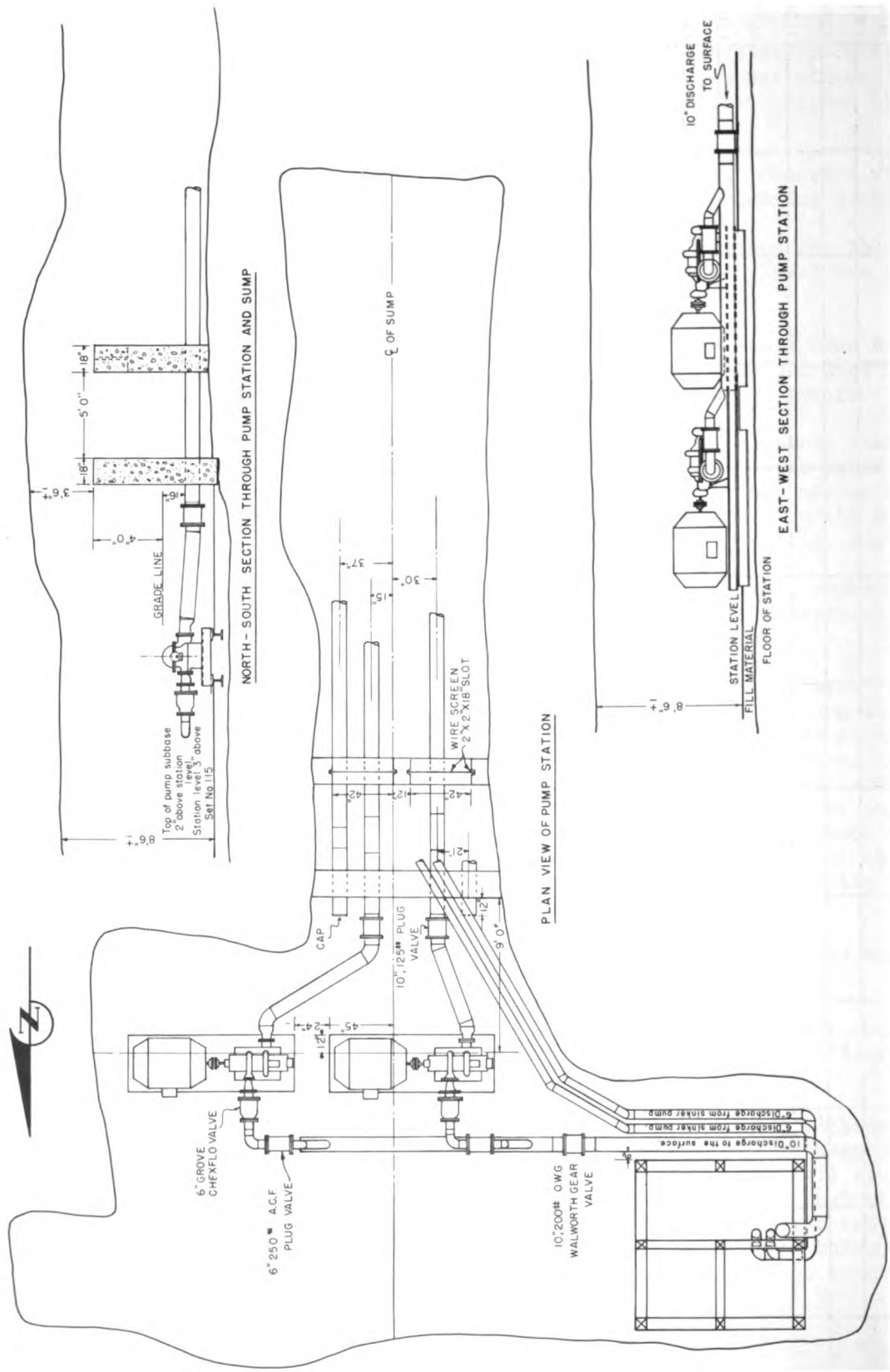
NORTH - SOUTH SECTION THROUGH PUMP STATION AND SUMP
GRADE LINE
Top of pump subbase 2' above station Invert 3' above Station level Set No 115
℄ OF SUMP
WIRE SCREEN 2"X2"X18"SLOT
PLAN VIEW OF PUMP STATION
CAP
10",125# PLUG VALVE
6"GROVE CHEXFLO VALVE
6" 250# A.C.F PLUG VALVE
10"200# O.W.G WALWORTH GEAR VALVE
10"Discharge to the surface
6"Discharge from sinker pump
6"Discharge from sinker pump
10" DISCHARGE TO SURFACE
EAST-WEST SECTION THROUGH PUMP STATION
STATION LEVEL
FILL MATERIAL
FLOOR OF STATION

Figure 14. - T. L.-shaft 600-foot level semipermanent pump station.

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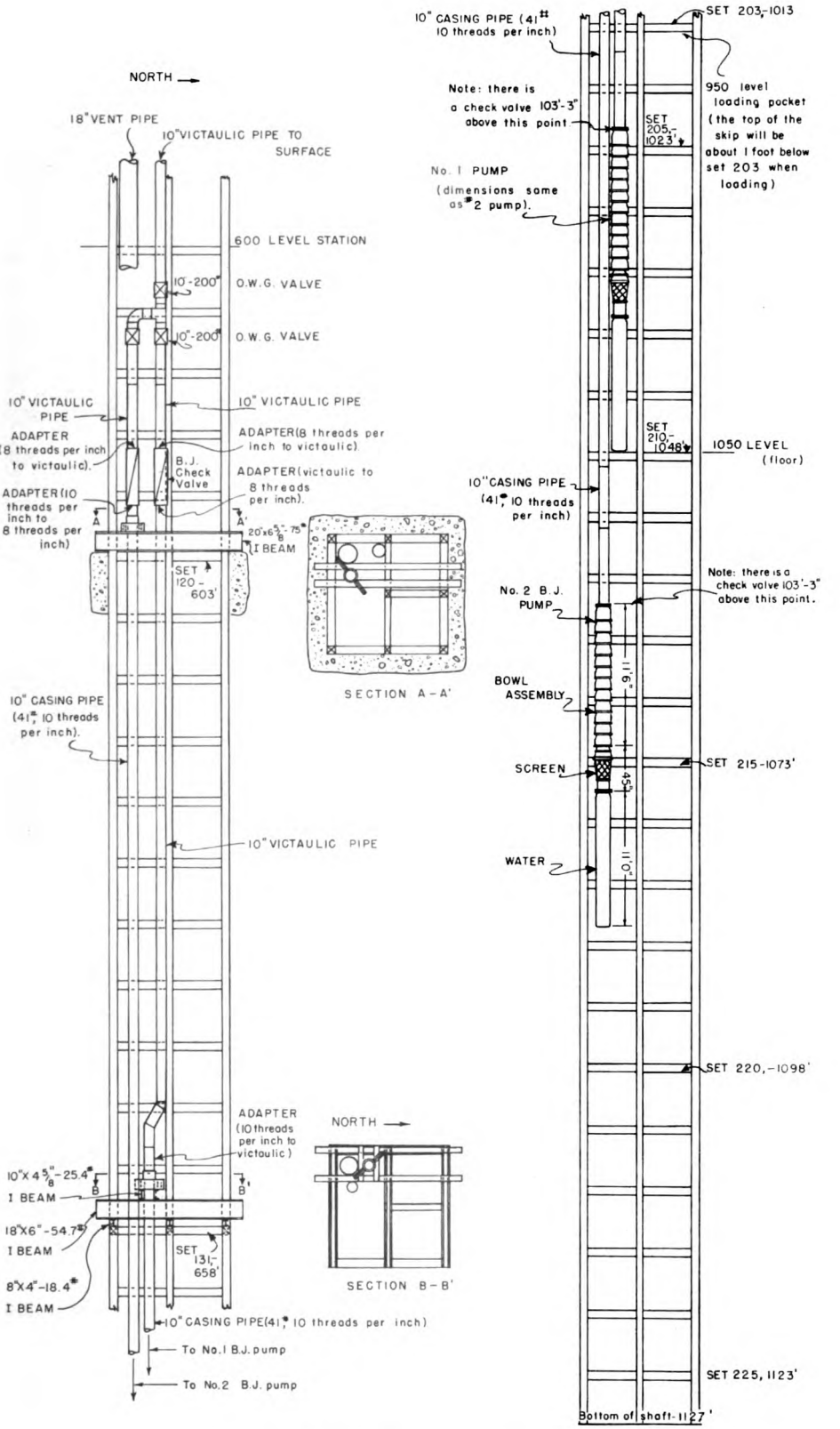

Figure 15. - Byron Jackson pumps.

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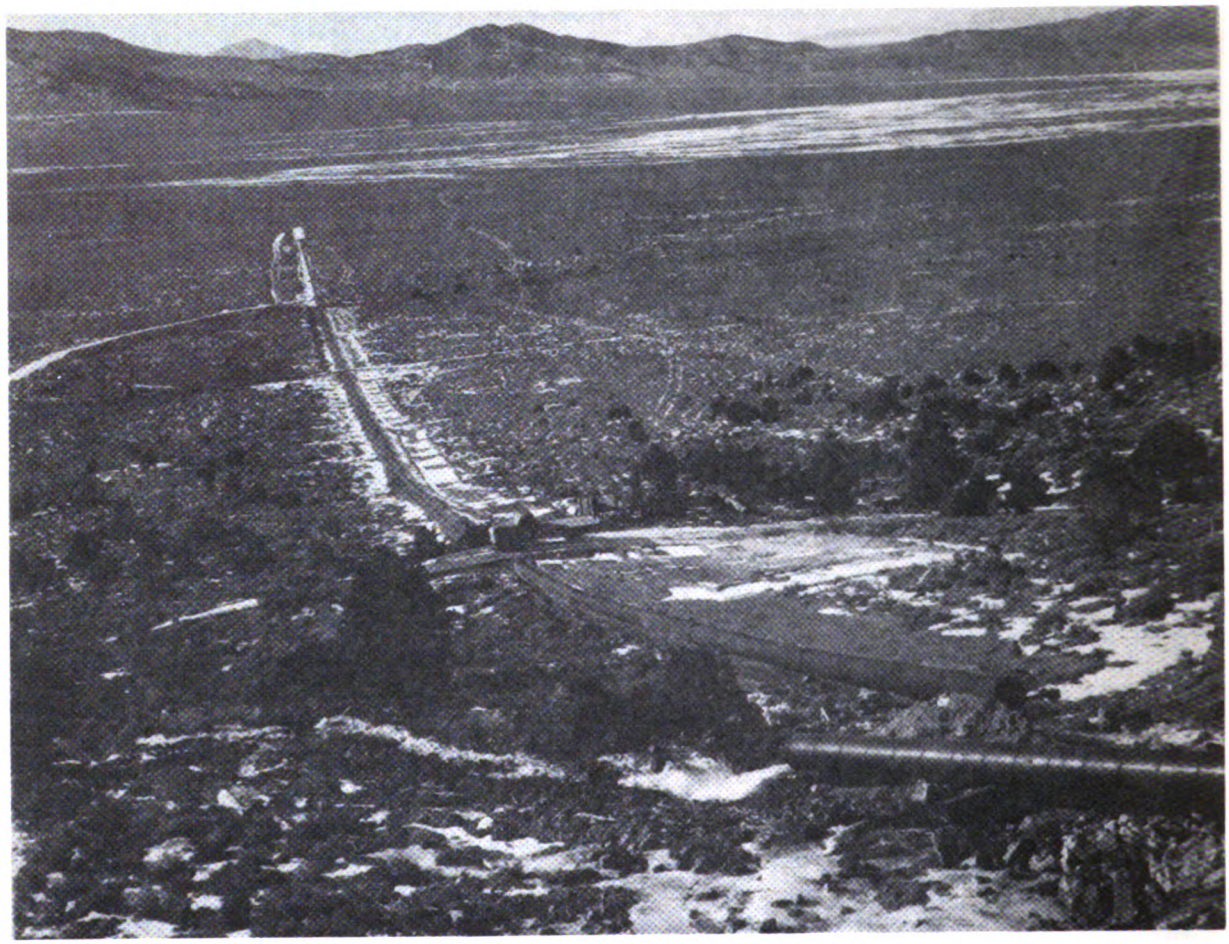

Figure 16. - Water-discharge pipe from T. L. shaft.

SCALE OF WAGES

The scale of wages paid follows:

	Dollars per day
Hoistmen	$17.88 plus half bonus
Deckmen (topmen)	15.26 plus half bonus
Blacksmiths	17.38
Surface laborers	14.00
Shaftmen	17.86 plus full bonus
Electricians	17.38
Mechanics	17.38
Carpenters	17.38
Shaft leaders	18.90

The bonus for shaftmen averaged from $4 to $5 per day. The topmen and hoistmen averaged one-half the bonus paid to shaftmen.

TABULATION OF DATA

Information concerning cost distribution for the various phases of shaft sinking, March 1954 to August 1955, are shown in tables 1 to 5.

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TABLE 1. - Man shifts for T. L. shaft, mechanical and surface

Month and year	Advance footage	Shifts				Station cutting, cu. ft.	Drifting, footage	Remarks
		Mine	Mech.	Surface	Total			
Dec. 1953		108.0	96.75	211.562	416.312			Site preparation, pouring concrete collar, erecting headframe, and building hoist room.
Jan. 1954	38	136.875	50.125	282.0	469.0			
Feb. 1954		86.125	21.5	327.687	435.312			
Mar. 1954	62	353.625	61.125	229.625	644.375			
Apr. 1954	179	458.0	117.75	96.25	672.0			
May 1954	181	534.375	52.25	107.25	693.875	1,560		Cut 2 diamond-drill stations.
June 1954	134	552.50	53.875	106.25	712.625			
July 1954	61	531.75	54.0	102.875	688.625	5,356		Cut 600-level pump station.
Aug. 1954	52	591.375	53.5	89.875	734.750			
Sept.1954	76	572.25	60.875	134.375	767.50			
Oct. 1954	70	625.812	71.75	70.125	767.687	2,060		Cut diamond-drill station and part of 850-level station. Dry-packed and timbered area adjacent to 850 level.
Nov. 1954		571.25	77.625	79.125	728.00			
Dec. 1954	34	570.437	101.75	89.125	761.312			
Jan. 1955	19	657.0	84.375	69.375	810.75	6,225		Cut 850-level station.
Feb. 1955		583.50	91.125	100.50	775.125	6,996	91	Finished cutting 850-level station and drifted north and south on 850 level.
Mar. 1955		624.375	111.0	147.625	883.0		70	Drifted north on 850 level.
Apr. 1955	30	629.125	85.375	91.5	806.0			Advance during December 1954.
May 1955	55	616.625	87.375	149.75	853.75			January 1955 and April 1955 made by moiling. No explosives used because of bad ground.
June 1955	50	638.75	111.625	173.625	924.0			
July 1955	71	604.937	104.5	169.375	878.812			
Aug. 1955	15	193.5	12.75	34.5	150.75			
Total	1,127	10,150.186	1,561.00	2,862.374	14,573.560	22,197	161	

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TABLE 2. - Personnel

	Number of men per shift	Number of shifts	Total per 24 hours or cycle
Underground:			
Mine foreman	1/3	3	1
Drilling and blasting, Mucking, Timbering	3	3	9
Surface:			
Hoisting	1	3	3
Shaft topmen	1	3	3
Steel and drill-repair shops	2.5	1	2.5
Miscellaneous	4.5	1	4.5
Feet sunk			1,127
Feet timbered			1,127
Feet concreted			33

TABLE 3. - Cost distribution, percent of total cost

	Labor and super-vision	Drills, steel, etc.	Explo-sives	Power	Timber	Equip-ment	Con-crete	Total
Drilling and blasting	11.448	0.230	3.071	5.087		0.409		20.245
Mucking	17.173			7.631		1.363		26.167
Timbering	10.631			4.724	3.696			19.052
Cutting stations	6.927		.430	3.407	.418			11.282
Preparing site and sinking plant	4.109				1.976		6.745	12.830
Pumping				3.475		6.950		10.424
Total	50.288	.230	3.501	24.324	6.190	8.722	6.745	100.0

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TABLE 4. - Costs in units of labor, power, materials, and supplies

Labor (man-hours per foot):		
Breaking, drilling, and blasting	man-hours	13.23
Mucking	do.	19.84
Timbering and timber framing	do.	12.28
Hoisting (hoist engineers)	do.	13.41
Rock disposal (topmen)	do.	13.41
Pumping	do.	0
Miscellaneous shaft labor (all others not included above)	do.	20.32
Surface labor (shops and miscellaneous)	do.	11.08
Supervision	do.	4.38
Total labor per foot of shaft	do.	107.95
Feet of shaft per man-shift	feet	.074
Power and supplies (units per foot of shaft):		
Explosives, 40-percent gelatin	pounds	20.00
Drill steel	do.	1.61
Timber for shaft sets, lagging, blocking, and wedges.	board feet	200.
Power	kw.-hr.	3,726.708

TABLE 5. - Performance records and general data

Time worked in shaft	days	630.
Progress made	feet	1,127.
Progress per day	do.	1.789
Rounds completed	rounds	226.
Progress per round	feet	5.
Man-shifts for miners and bosses	shifts[1/]	14,573.560
Man-shifts for timbermen	do.	1,729.945
Drilling	man-hours	14,910.21
Number of holes drilled per round	holes	35.
Drill bits used per round	bits[2/]	0.
Footage drilled per man-hour	feet	3.183
Footage drilled per foot advanced	do.	42.
Blasting and blowing	man-hours	3,051.
Explosives used per foot of shaft	pounds	20.
Mucking	man-hours	22,359.68
Effective excavation	cubic feet	136,367.
Effective excavation per bucket	do.	27.
Effective excavation per man-hour (mucking time)	do.	6.099
Total timbering time	man-hours	13,839.56
Labor per set placed and lagged	do.	61.24
Labor stations	do.	2,641.68
Stations excavated	cubic feet	22,197.

1/ 1 shift represents 8 hours, collar to collar.

2/ A total of 364 Ingersoll-Rand type-I steel jackbits and 81 Timken carbide insert bits were used during the entire sinking operation.

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